

# Transportation Security Activities in Texas

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**ABSTRACT:** Texas has the largest bridge inventory of any state, with nearly 33,000 on-system and 17,000 off-system bridges. This inventory, coupled with the state's extensive land area, shoreline, and border with Mexico, makes transportation security a challenging task for the state.

The Texas Department of Transportation (TxDOT) has embarked on a five-step approach to transportation security. The first step is identifying the state's most critical bridges. TxDOT recognizes that budget constraints require focusing on only the most critical structures. Second, once the most critical structures are identified, options are developed for deterrence, surveillance, and protection of those structures, tailored to each specific location. Third, because in-house expertise is not sufficient to cover all the aspects that are needed in this wide-ranging effort, research in cooperation with outside experts in various specialized security-related fields is initiated. Fourth, military transportation needs are addressed because our highways and bridges form a vital link in the defense transportation network of this country. And finally, a process is developed that will provide the training, procedures, and communication channels--both internally and with other federal, state and local agencies--to ensure that TxDOT is prepared to deal with potential security threats.

## IDENTIFYING THE CRITICAL BRIDGES

TxDOT uses a two-step process to rank critical bridges across the state. The first step is an automated ranking of all the bridges listed in the National Bridge Inventory (NBI) for the state. This

ranking is accomplished through the use of a Microsoft Access program using the Texas Bridge Criticality Formula given in Eq. (1). The formula accounts for several criteria that are measured using data available from the National Bridge Inspection database that can be downloaded to the Access program.

The criteria incorporated into the formula were those items TxDOT considered important, based, in part, upon the responses to an AASHTO/TRB Task Force survey that helped define and prioritize these criteria. The joint survey, titled "Security and Emergency Response Survey of State Transportation Agencies", was a cooperative effort of the AASHTO Task Force on Transportation Security and the TRB Task Force on Critical Transportation Infrastructure Protection. The criteria included the economic impact due to disruption of commerce, which was quantified in the TxDOT formula in terms of Average Daily Truck Traffic. General passenger transportation needs and risks to public safety were considered in terms of Total Average Daily Traffic (ADT) and Detour Length. Connectivity, which represents the ripple effect within the highway system, was considered in terms of the ADT of intersecting routes, and whether the bridge in question represented an interstate-to-interstate interchange. Another criterion was whether a damaged bridge could restrict navigation access to important waterways, and was determined by whether a Coast Guard permit was required for that particular structure. Given Texas' border with Mexico and the importance of international trade, another criterion was whether the bridge was an international crossing. The inclusion of the bridge on the Strategic Highway Network, which functions as a system of primary routes for the movement of military personnel and supplies, was another consideration. And finally, the bridge type and maximum span length were used to determine a repair/replacement

index, which represents a measure of the cost and ease of repair of a particular structure.

As part of the formula, the relative importance given to each criterion can be adjusted by the use of a weighting factor to reflect the value TxDOT assigns to each different criterion. Should the relative importance change in the future, the various weighting factors can easily be changed and a new listing of bridges can be obtained.

TEXAS BRIDGE CRITICALITY FORMULA-The following equation represents Texas' formula for ranking bridge criticality.

(1)

Criticality Index =  $\{[(\text{Truck ADT} \times \text{Truck ADT Factor} / \text{Max. Truck ADT}) + (\text{ADT} \times \text{ADT Factor} / \text{Max. ADT}) + (\text{Detour} \times \text{ADT} \times \text{Detour Factor} / \text{Max. Detour} \times \text{Max. ADT}) + (\text{Intersect Rt. ADT} \times \text{Intersect Rt. Factor} / \text{Max. Intersect Rt. ADT}) + (\text{Interstate Intersection} \times \text{Interstate Intersection Factor}) + (\text{Navigation Importance} \times \text{Navigation Factor}) + (\text{International Importance} \times \text{International Factor}) + (\text{Military Importance} \times \text{Military Factor})] / 8\} \times \text{Replacement Factor}$

BASIC ELEMENTS OF THE FORMULA-The Texas Bridge Criticality Formula has the following elements and definitions.

#### Commerce Criteria

- Truck ADT = Average Daily Truck Traffic based on Item 109 of the Bridge Inspection Data Base (BIDB) for the subject bridge.
- Max. Truck ADT = The maximum Truck ADT for any bridge in the BIDB for the entire state.
- Truck ADT Factor = Numeric factor, nominally between 0 and 1, that relates the relative importance of this criterion to the other criteria in the formula.

#### Transportation Needs Criteria

- ADT = Average Daily Traffic based on Item 29 of the BIDB.
- Max. ADT = The maximum Truck ADT for any bridge in the BIDB for the entire state.
- ADT Factor = Numeric factor, nominally between 0 and 1, that relates the relative importance of this criterion to the other criteria in the formula.
- Detour = Bypass, Detour Length based on Item 19 in the BIDB.
- Max. Detour = The maximum Detour Length for any bridge in the BIDB for the entire state.
- Detour Factor = Numeric factor, nominally between 0 and 1, that relates the relative

importance of this criterion to the other criteria in the formula.

#### Connectivity Criteria

- Intersect Rt. ADT = Average Daily Traffic on the Intersecting Route
- Max. Intersect Rt. ADT = The maximum Average Daily Traffic on the Intersecting Route for any bridge in the BIDB for the entire state.
- Intersect Rt. Factor = Numeric factor, nominally between 0 and 1, that relates the relative importance of this criterion to the other criteria in the formula.
- Interstate Intersection = 1 if both main and intersecting routes are Interstate Highways, or 0 if one or both are not Interstate Highways.
- Interstate Intersection Factor = Numeric factor, nominally between 0 and 1, that relates the relative importance of this criterion to the other criteria in the formula.

#### Navigational Access Criteria

- Navigation Importance = 1 if the bridge requires a Coast Guard Permit based on Item 38 in the BIDB, or 0 if no Coast Guard permit is required.
- Navigation Factor = Numeric factor, nominally between 0 and 1, that relates the relative importance of this criterion to the other criteria in the formula.

#### International Access Criteria

- International Importance = 1 if the bridge borders on Mexico based on Item 98 on the BIDB, or 0 if it does not.
- International Factor = Numeric factor, nominally between 0 and 1, that relates the relative importance of this criterion to the other criteria in the formula.

#### Military Movement Criteria

- Military Importance = 1 if the bridge is located on the Strategic Highway Network based on Item 100 in the BIDB, or 0 if it is not.
- Military Factor = Numeric factor, nominally between 0 and 1, that relates the relative importance of this criterion to the other criteria in the formula.

#### Replacement /Repair Index

- Replacement Factor = Structural Complexity x Span Length Factor, where:  
*Structural Complexity* = one of three numeric factors based on if the superstructure type's complexity is rated low, medium or high. These numeric factors nominally range between 0 and 2. All bridge superstructure types from Item 43 of the BIDB were rated as being low, medium or

high and the numeric factor are assigned accordingly.

*Span Length Factor* = one of three numeric factors based on the length of the main span of the bridge. These numeric factors nominally range between 0 and 2. Span lengths based on Item 48 of the BIDB are grouped as less than 150', 150' to 300' and more than 300', with numeric factors assigned accordingly.

Through the use of the Microsoft Access program, the Criticality Indexes for all bridges in the NBI for the state were calculated and ranked. The information contained in the NBI Database for the top ranking bridges was verified to ensure that any errors in the data from the NBI Database would not skew the results for the Criticality Index calculations.

The second step of the procedure to determine the most critical bridges involved incorporating the addition of other bridges not included in the automated process. As with most state transportation departments, Texas is divided into a number of districts. These districts also evaluated the bridges in their geographic areas of responsibility and provided input on bridges that they felt were critical. Given their local perspective, they were able to identify issues, including site-specific conditions, which were not identifiable in the NBI data. These local factors included the lack of adequate capacity on available detour routes; being the only access to schools, hospitals, large office complexes, or industrial areas; important utilities carried across the bridge; proximity to hazardous facilities such as chemical plants and refineries; and location on hurricane evacuation routes.

The structures that were obtained from the two independent processes were then merged into a final listing of critical bridges. An initial listing of 80 critical bridge locations was obtained through this process. This listing is being used as the basis of further analysis for threats, vulnerabilities and possible countermeasures.

#### DETERRENCE, SURVEILLANCE, and PROTECTION OPTIONS

The second item in the five-step approach to transportation security is developing deterrence, surveillance, and protection options. The primary purpose of such countermeasures is to reduce either the potential for or consequences of attacks on critical structures.

Among the deterrence techniques that have been examined for Texas' bridges are:

- Eliminating parking areas beneath the bridges,
- Restricting ingress and egress routes from adjacent areas through the use of fencing or other barriers,
- Limiting access to important bridge components by securing or removing ladders and inspection platforms,
- Providing additional lighting,
- Limiting and monitoring access to plans of existing bridges, while ensuring our compliance with Open Records legislation.

Some of the surveillance options being considered for transportation security include:

- Clearing of vegetation to provide clear lines of sight,
- Installing motion sensors and other active sensors to monitor sensitive areas,
- Installing closed-circuit television (CCTV) surveillance cameras to operate in conjunction with existing Intelligent Transportation System (ITS) environments,
- Notifying local law enforcement officials of which bridges have been determined to be critical and requesting increased patrols.

Protection options for critical bridges under consideration include:

- Providing barriers or other protection for bridge columns that are outside the roadway clear zone to protect against an intentional ramming attack,
- Providing pass-through gates in continuous concrete median barriers to enable rerouting of traffic and access for emergency vehicles,
- Installing advanced warning systems to warn motorists of potentially hazardous conditions on a bridge.

The options for deterrence, surveillance, and protection selected for a particular location must be carefully analyzed to ensure that the costs associated with the selected options are commensurate with the benefits derived. Especially for the equipment- and personnel-intensive items, the long-term maintenance and operating costs must be considered, as well as the initial capital outlays. Many of these options are much less expensive if they are incorporated into the original design of a project rather than retrofitted at a later time.

## SECURITY RESEARCH ACTIVITIES

The third step in the TxDOT security approach is sponsoring research on those issues for which there was limited in-house experience. In sponsoring such research TxDOT realized that the topics chosen must add value to the process, be implementable in a reasonable time period, and provide cost-effective solutions. The topics selected were non-traditional for Department of Transportation-sponsored research in that transportation security is simply not an issue that has been examined in depth before. Similarly, TxDOT's research partners in academia have not investigated these subjects in the past, and, therefore, they will also need to involve outside resources.

The first area that was selected for research effort was the design of bridges for security, to result in design solutions that reduce the threat and mitigate the consequences of terrorist acts.

With respect to bridge design for security, fundamental differences could exist between the forces imposed upon a structure from a natural disaster and those from a terrorist attack. Bridges that are hardened for natural disasters such as earthquakes, floods, and wind, are not necessarily hardened for terrorist attack. Solutions are needed that reduce the threat and mitigate the consequences of such attacks. We need innovative design solutions that are based on an assessment of consequences of terrorist threats instead of replicating designs based on consequences of natural disasters.

To meet these requirements, TxDOT has sponsored a research project on "Design of Bridges for Security." This project was awarded in March 2002 to the Center for Transportation Research at the University of Texas at Austin. It is a two-phase project, with Phase I being a literature search and work plan. A report on Phase I will be presented later this summer. Phase II will be contingent on the results of Phase I and will include guidelines to implement cost-effective measures to improve bridge security.

A second area of research that was selected concentrated on quickly responding to the possible consequences of a terrorist attack. This research seeks to identify strategies and technologies to restore the use of a bridge quickly in the event it is damaged or destroyed in an attack. The process may use simple technologies that already exist. The benefits of this research will carry over into

situations involving bridge loss due to floods and earthquakes, as well.

In this area, TxDOT has sponsored a research project on "Rapid Bridge Replacement." This project was awarded in March 2002 to Texas Tech University. This project is also a two-phase project, with Phase I as a literature search of all expedient and cost-effective repair and replacement techniques. This work will be completed later this summer. Again, Phase II will be contingent on the results of Phase I. Phase II will evaluate all the techniques and incentives for rapid bridge replacement from both civilian and military sources. Phase II will also demonstrate case studies as examples.

Both of the aforementioned projects were initially internal TxDOT-sponsored research projects. Recognizing the value that these projects will have to other states, as well as the advantages of getting other states' perspectives on these subjects, the projects are being changed to Texas-led pooled-fund projects. As such, the project scopes will be broadened and more funding will be made available. Solicitations to other states to participate in these pooled-funded projects have been made. A kickoff meeting has been scheduled for September 2002. At this meeting the respective researchers will present the results of their Phase I work and their proposed work plans for their Phase II efforts.

Still another area that TxDOT envisions as an important aspect for the security of our bridges is the field of surveillance technologies. With respect to research with surveillance systems, an FHWA-sponsored pooled-fund project is being initiated to look into this field. This project will look at low-cost, easy-to-implement protection and optimization issues for various bridge types. The project will also examine state-of-the-art technology and how that technology can best be used.

## ENSURING MILITARY MOBILITY

The fourth step in TxDOT's transportation security approach is making sure that military mobility needs are met. It should be noted that addressing military mobility needs is already part of TxDOT's standard operating procedure, but these procedures were reviewed to ensure that they met the military's needs was in order. In Texas, the National Guard coordinates all military movements. TxDOT assists the National Guard by providing approved routes and checking bridge capacities.

Most large-scale military movements in the state use the Strategic Highway Network (STRAHNET).

TxDOT also provides numerous pre-approved non-STRAHNET routes for single-vehicle moves. These are re-evaluated every two years to account for the changing conditions of the highway and bridge elements as well as additions of new construction to the system. TxDOT will routinely approve bridges on a route within 10 days and can accommodate same-day reviews.

TxDOT recently participated in a Military Mobility Exercise sponsored by the Federal Highway Administration that simulated large-scale movements of military equipment and personnel. The purpose was to improve the coordination between the military and affected civilian agencies to ensure the effective movement of forces from their home bases to various ports of embarkation.

#### ENSURING PREPAREDNESS

The fifth and final step in TxDOT's transportation security approach is ensuring preparedness to deal with the consequences of possible security threats. This preparedness includes training, procedures, and internal and external communication to ensure an expedient and effective response to all forms of security threats or actions.

Prior to the events of September 11, TxDOT had participated in a number of different exercises. Several of TxDOT's districts participated in a Weapons of Mass Destruction Exercise. These have been held in the urban areas and involved participation by local, state, and federal agencies such as the Federal Bureau of Investigation, Drug Enforcement Administration, and US Army. The exercises were designed to prepare for events such as large hazardous materials (HAZMAT) incidents and biological agent dispersals. These exercises are designed to optimize coordination among the local, state, and federal agencies that could be involved in weapons of mass destruction events.

TxDOT was one of 25 state agencies that participated in a Foreign Animal Disease Exercise last year at Texas A&M University. Although the exercise was focused primarily on preventing the spread of hoof-and-mouth disease, the same methods used during this exercise could be applied in cases of a bioterrorism attack. Should some sort of outbreak occur, TxDOT maintenance crews would help contain affected areas by blocking roadways and controlling access to the affected area.

TxDOT has developed an Emergency Highway Traffic Regulation Plan, which is a system of traffic management and control devised to regulate the use of highways and to expedite and facilitate urgent vehicle movement by highway just before, during, and just after a national security emergency. In addition, site-specific emergency response procedures are being developed for each of the bridges that have been determined to be critical to the state's transportation system. These emergency response procedures will include such areas as traffic control plans, detour plans, debris management plans, sources for key components, lists of qualified contractors, emergency response contacts and lists and phone numbers of key personnel.

TxDOT is also a resource agency for the Texas Governor's Task Force on Homeland Security. This task force coordinates efforts to detect and deter threats to the state. Its purpose is to assure Texans of state and local preparedness to respond to such threats. It assesses the ability of state and local governmental agencies to respond to threats and to effectively provide victim assistance and aids coordination among federal, state and local efforts. The Task Force has developed recommendations on how to improve Texas' ability to detect, and to develop and coordinate a response to, terrorist events. It also helps coordinate state efforts with the Federal Office of Homeland Security.

TxDOT is currently participating with the New Mexico State Highway and Transportation Department and Sandia National Laboratories in the development of the Integrated Transportation Analysis (ITA) system. The ITA is a web-based application for sharing intelligence information in real time among state DOTs, the US Department of Transportation, and the nation's security and law enforcement agencies. The initial demonstration of the system took place on July 3, 2002. It is hoped that the ITA system will provide integration of national level security assets, information, alerts and warnings into a common pathway that can be delivered through the US DOT/FHWA and on to the various state DOTs.

A final aspect of ensuring preparedness includes the field of training. The American Association of State Highway Transportation Officials (AASHTO) Task Force on Transportation Security is sponsoring terrorism recognition and awareness training in cooperation with the Washington State DOT. When developed, this training will be given to all TxDOT personnel, with special emphasis on those

employees who spend significant time in the field, such as maintenance personnel. These are the individuals who have the best opportunity to observe and report the kind of suspicious activities that can help to prevent or minimize the consequences of terrorist action.

#### SUMMARY

The tragic events of September 11, 2001 require that transportation agencies across this country elevate the security of their critical transportation infrastructure to a central priority. Achieving that goal will be difficult and costly but necessary. TxDOT is currently in the early stages of determining the security needs related to its transportation assets and will continue to partner with other public agencies, with academia, and with private industry to address these needs. With limited funding available, the addition of true value from any security implementation strategies must be ensured.

This is a process that will require a sustained, long-term effort and a new perspective on the way that State DOTs do business. The TxDOT five-step approach to transportation security can act as a resource for states that have yet to begin this process. Cooperation and the sharing of information will be crucial for success in the ultimate goal of ensuring the safety and security of the traveling public.

#### ACKNOWLEDGEMENT

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